OSTRACODS FROM THE PORTLAND AND PURBECK BEDS OF THE AYLESBURY DISTRICT

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SYNOPSIS

The transition from Portland to Purbeck conditions in the Aylesbury district is discussed with the aid of three sections which are described and their ostracod faunas compared. A series of facies marking the transition can be recognized by means of the lithology, macrofauna and ostracods. No evidence of Middle or Upper Purbeck ostracods has been found. Seventeen genera and twenty-two species are described, of which three species are new.

INTRODUCTION AND ACKNOWLEDGEMENTS

The Portland and Purbeck Beds of the Aylesbury District have been the subject of study by geologists since the middle of last century. At that time Morris (1856) was able to demonstrate, with the aid of the lithology and macrofaunas of the beds exposed in the Bugle Pit, Hartwell, a change from marine Portland conditions through estuarine to freshwater Purbeck conditions. Jones (1885) described the ostracods from the Lower Purbeck Beds of this area and thought that the mingling of the marine with freshwater ostracods would repay careful study. Jukes-Browne (*in* Woodward 1895), Chapman (1899), Merrett (1924) and Sylvester-Bradley (1941) have each noted a transition from marine Portland to freshwater Purbeck based on the study of the ostracods. Some geologists such as Jones (1885), Chapman (1899) and Merrett (1924) have suggested that Middle and even Upper Purbeck ostracods may be present in places. This has not been confirmed in the present investigation, though Casey & Bristow (1963, 1964) believe sands (previously regarded as Cretaceous) containing Middle Purbeck lamellibranchs, in the Whitchurch and Stewkley area, can be interpreted as the transgressive margin of the Cinder Bed.

The present paper attempts to investigate the nature of the transition from Portlandian to Purbeckian conditions in the Aylesbury district by means of a study of the ostracod fauna. The work is based mainly on the fieldwork and collections made by Prof. P. C. Sylvester-Bradley in the Thame Valley during the summer of 1939. Samples were examined from exposures at the following localities :

1. AY Aylesbury. A pit about half a mile south west of Walton Court Farm—on the footpath that leads from Bishopstone to Ceely Road, Southcourt Estate, 42/806112.
2. BP Bugle Pit, Hartwell near Aylesbury, 42/794121.
3. CH Coneyhill. Field pit near the lodge to Eyethorpe, 42/759151.
4. CL Creslow. Small overgrown pit near cottages, 42/811219.

5. CP Cuddesden Palace. Field pit north east of Cuddesden Palace, 41/602032.
6. CW Long Crendon. CWA, B—auger borings by the site of the old windmill, 41/693093. CWC, D, E were small pits by the side of the road, 41/689093.
7. GN Garsington village, Clinkards Farm. Excavations to the north side of the village on the west side of the ridge, GNA-G, 41/586028.
8. HD Haddenham. Pit one mile east of Haddenham on the lower Aylesbury Road, HDA, B 41/763096.
9. HG Hurdlesgrove Farm. Field pit a little south of Hurdlesgrove Farm about one mile north of Whitchurch on the Buckingham Road, 42/804228.
10. NW Excavations one mile north of Whitchurch on the Buckingham Road, NWA-F, 42/805225.
11. OV Oving. A pit south of the North Marston Road, 42/793212.
12. TW Towersey, half a mile north of the village on the eastern side of the Kingsey Road, 41/735059.
13. WH Warren House Farm near Stewkley, pit south of the farm, 42/851242.

The sections then extant are now filled in or overgrown but the three most complete sections are described below.

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All the figured material forming the basis of the present paper has been deposited in the collections of the British Museum (Natural History).

FACIES

Davies (1899) stated that he used the term Purbeck as a facies name and not as a time name. This use of the term is followed here and five successive facies are distinguished in the Portland and Purbeck Beds of the Aylesbury district. These facies are listed in ascending order as follows :

A. At the base are massive cream coloured limestones of the Portlandian containing ammonites such as *Titanites giganteus* (J. Sowerby), *Titanites pseudogigas* (Blake), which were described from this area. Woodward (1895) noted large lamellibranchs which he identified as *Perna bouchardi*, *Cardium dissimile*, *Pecten lamellosus*, *Trigonia gibbosa* var. *manselli*. Marine ostracods are also present. This is referred to as the Portland facies.

B. Laminated marls and limestones with, according to Woodward (1895), *Trigonia gibbosa* var. *manselli* and *Ostrea expansa*, together with fish remains and a mixture of marine and euryhaline ostracods. This is referred to as the marine Purbeck facies.

C. Laminated marls and limestones containing gastropods which Davies (1899) tentatively identified as species of *Paludina*. Fitton (1836) reported *Cyclas parva*, modiolae, *Planorbis* and mytili from these beds. Fish remains and euryhaline ostracods are also to be found. This is the brackish Purbeck facies.

D. Marls and limestones becoming sandy upwards with *Paludina* and small modiolae and a *Cyclas*? reported by Fitton (1836). Freshwater beds of similar age at Swindon have yielded (Sylvester-Bradley 1941) *Physa bristovii* (Forbes MS) Phillips, *Valvata helicoides* (Forbes MS) de Loriol, *Viviparus inflatus* (Sandberger), *Clavator reidi* Groves and *Clavator grovesi* Harris. This is the oligohaline Purbeck facies.

E. Sands and sandstones of the Whitchurch region containing marine lamellibranchs. Casey has recently identified some specimens first collected by Bristow as Middle Purbeck in age. (Casey & Bristow 1963). No ostracods have been obtained from these beds.

These five facies demonstrate a gradual change from marine Portland to more or less freshwater beds of the Lower Purbeck and back again to the marine sands of the Middle Purbeck.

The beds classed as Middle or Upper Purbeck in age by Jones, Chapman and Merrett were of facies D, i.e. oligohaline. The occurrence of Middle Purbeck ostracods is based on two figures of *Cypridea granulosa* var. *paucigranulata* Jones (1885). The specimen on which his figures are based comes from a locality called Whitchurch, the existence and position of which is very doubtful, (see Sylvester-Bradley 1949). I have not found any specimens of *Cypridea granulosa* or its varieties in the Aylesbury district.

In many descriptions of the Purbeck Beds, the terms freshwater, marine, estuarine and brackish have been used without discussion. The writer considers the Purbeck ostracods to be either oligohaline, euryhaline or marine, partly on account of relationships to living representatives of known habitat, partly according to their association with other fossils, and partly on account of the lithological conditions of the beds enclosing them. Those ostracods found in both oligohaline and marine conditions are considered to be euryhaline, i.e. capable of existing under widely varying conditions of salinity. When euryhaline forms are found in the absence of marine or oligohaline ostracods it would appear that conditions of salinity variation were at their maximum. In the beds under discussion the marine ostracod fauna is characterized by :

Macrodentina (*Macrodentina*) *rugulata* (Jones)
Macrodentina (*Macrodentina*) *transiens* (Jones)
Macrodentina (*Dictyocythere*) *retirugata* (Jones)
Protocythere serpentina (Anderson)
" *Macrocypris* "? sp. Anderson
Paraschuleridea buglensis sp. nov.
Orthonotacythere rimosa Martin
Procytheropteron brodiei (Jones)
Wolburgia visceralis (Anderson)

Table I

	1	2	3	4	5	6a	6b	6c	7	8	9	10	11a	11b	11c	12	13	14	15	16	17	18	19	20
Macrodentina (Macrodentina) rugulata	..	..	..	..	..	33	99	51	45	288	4	86	..	..	..	..	..	..	..	..	..	..	..	..
Macrodentina (Macrodentina) transiens	16	1	17	303	49	91	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Macrodentina (Dictyocythere) retirugata	..	..	..	..	..	50	190	90	31	166	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Protocythere serpentina . .	26	3	82	98	12	68	1	39	3	111	1	..	..	..	..	..	11	..	..	..	..	..	..	..
" *Macrocypris* "? sp. . .	..	..	..	..	..	2	..	1	1	9	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Paraschuleridea buglensis . .	22	3	36	4	24	68	10	11	11	68	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orthonotacythere rimosa . .	..	..	1	14	..	..	..	38	6	17	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Procytheropteron brodiei . .	..	..	7	..	..	..	6	64	54	104	..	..	..	..	..	..	..	..	..	13	..	..	1	..
Wolburgia visceralis . . .	54	..	19	1	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..
Fabanella boloniensis . .	..	1	..	..	..	8	..	..	2	57	51	6	14	4	55	100	..	..	24	36	2	6	107	33
Fabanella ansata . . .	..	..	..	..	2	5	..	..	1	85	65	50	20	15	33	623	..	..	..	..	..	..	45	11
Mantelliana purbeckensis . .	..	..	..	..	..	..	..	..	..	..	..	..	..	8	100	21	..	1	..	7	1	..	77	24
Cypridea tumescens praecursor .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	15	8	2	..	10	6
Cypridea dunkeri . . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	4	1
Klieana alata	..	..	..	..	..	..	..	..	..	..	..	10	..	..	..	..	..	243	63	23	5	..	150	98
Darwinula leguminella . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..
Ilyocypris (Rhinocypris) jurassica . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..
Dicrorygma fragilis . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..
Dicrorygma decipiens . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..

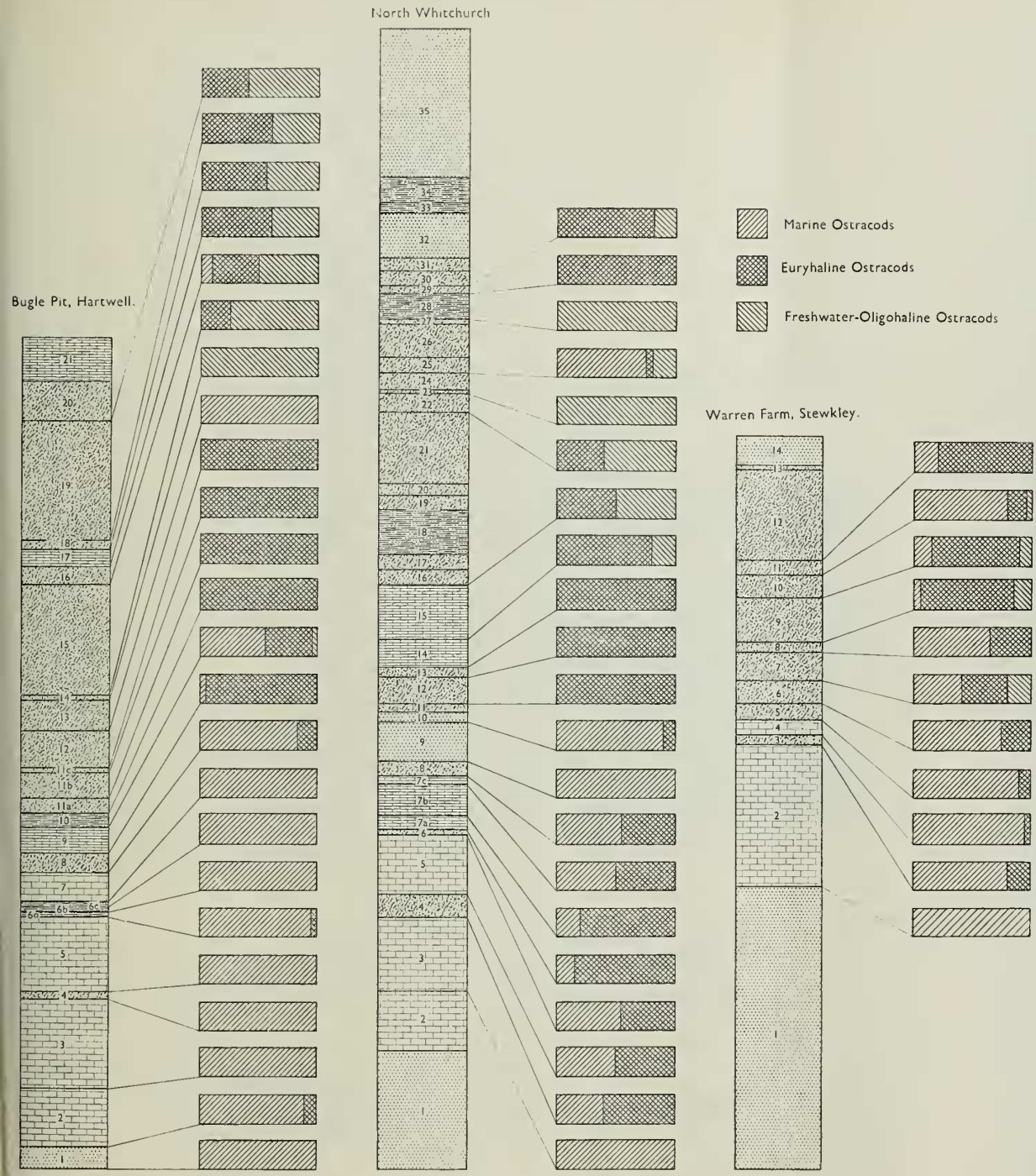

FIG. 32. Lithological variation and proportion of marine, euryhaline and oligohaline ostracods present in the sections at Hartwell, Whitchurch and Stewkley. Numbers on the columns refer to those given in the text description of each section.

The euryhaline fauna is characterized by :

Fabanella bolonensis (Jones)
Fabanella ansata (Jones)
Mantelliana purbeckensis (Forbes)

The oligohaline fauna is characterized by :

Cypridea tumescens (Anderson) *praecursor* Oertli
Cypridea dunkeri
Klieana alata Martin
Scabriculocypris trapezoides Anderson
Darwinula leguminella (Forbes)
Rhinocypris jurassica jurassica (Martin)
Dicrorygma fragilis Martin
Dicrorygma decipiens (Anderson)

The ostracod faunas for the sections described below are given in Tables I–III, which show the number of valves found in the beds which contain ostracods.

THE BUGLE PIT, HARTWELL

The Bugle Pit seems to have been mentioned first in the literature by Morris (1856). Since then it has been described repeatedly. A comparison of the sections obtained by Woodward (1895), Merrett (1924) and Sylvester-Bradley (1939) is shown below.

In 1939 Professor Sylvester-Bradley examined the exposure and collected carefully from all the beds present. The material was subjected to a preliminary examination in the production of his papers of 1940 and 1941. This section is important in that it exposed the thickest continuous section in the Portland and Purbeck Beds in this area. The section has now almost disappeared under tip ; only about three feet of the upper beds could be seen at the south east of the quarry in 1962.

The ostracods obtained from the Bugle Pit have been plotted as shown in Table I. The sections at the three localities are drawn to scale and the relative percentages of the three faunas indicated for each bed in which ostracods are found. Four of the five facies indicated above are well developed in the Bugle Pit ; facies E and the upper part of the facies D are absent.

The Bugle Pit, Hartwell

		ft.	in.
BP 22	Very coarse grit (infilling what is apparently a solution pipe in the beds below)		
BP 21	Fine grained limestone, with occasional disseminated shells seen to	1	6
BP 20	Soft grey marl	1	4
BP 19	Grey pebbly marl up to . . . . . This bed cuts down and across an extremely uneven and eroded surface of the beds below.	4	0

				ft.	in.
W 11	M 10	*BP 18	Marly subsoil seen to		4
	M 9	*BP 17	Thin bedded broken shelly limestone		7
	M 8	*BP 16	Soft grey marl		7
	M 8	BP 15	Rubbly white chalky marl	3	9
	M 7	BP 14	Clayey brown marl		1½
	M 7	BP 13	Hard gritty marlstone	1	0
	M 6	BP 12	Marly shale with alternating layers of marlstone, ostracods at the base	1	3
	M 5	BP 11c	Ostracod marl with fishes		2
	M 4	BP 11b	Laminated shales with fishes		10
	M 3	BP 11a	Ostracod marl with shells and fishes		6
	M 2	BP 10	Soft black or brown shale		6
W 10	M 1	BP 9	Laminated blue hearted cementstone with plant and insect remains along partings	9–10	
W 9		BP 8	Tough highly bituminous shaley marl with large oysters and other lamellibranch casts		8
W 8		BP 7	Hard fine grained limestone with a band of *Trigonia* casts seen near the base	1	0
W 7		BP 6c	Marly shale	2–3	
		BP 6b	Black shales	2–3	
		BP 6a	Marly shale with a layer of lamellibranchs at the top		2
W 6		BP 5	Blue hearted marly limestone with large Portland lamellibranchs	2	6
		BP 4	Brown clay with serpulae		3
		BP 3	Blue hearted rather soft marly limestone, *Trigonia* etc.	3	0
W 5		BP 2	Hard blue hearted limestone with oysters, bottom 3 in. fossil casts	2	0
W 4		BP 1	Yellow brown sand seen to		9

W = H. B. Woodward's section 1895
M = Merrett's section 1924
BP = Sylvester-Bradley's collection 1939

NORTH WHITCHURCH

In 1939 Sylvester-Bradley opened up trenches by the roadside north of Whitchurch. The accompanying section is a composite one made up from the sections exposed in the trenches and at a pit in the field south of Hurdlesgrove Farm. Text-figure 32 shows the section and the proportions and ranges of the three ostracod faunas. Facies A, B, C and D can be recognized in this section and facies E is reported to be present near Whitchurch itself (Casey & Bristow 1964).

Table II

	3	4	5	6	7a	7b	7c	8	9	10	12	13	14	15	16	22	23	24	25	26	28	29	30	31
Macrodentina (*Macrodentina*) *rugulata*	..	40	44	85	5	6	40	51	12	14	..	..	..	..	..	..	..	..	6	..	..	..	..	..
Macrodentina (*Macrodentina*) *transiens*	..	..	51	28	5	2	14	13	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Macrodentina (*Dictyocythere*) *retirugata*	51	169	6	37	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Protocythere serpentina	9	..	7	..	..	..	2	10	52	..	..	..	..	..	..	..	..	..	6	..	..	..	..	..
Paraschuleridea buglensis	5	1	2	10	..	..	16	9	126	42	..	..	..	..	..	..	..	..	43	..	..	..	..	..
Procytheropteron brodiei	2	62	8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cythere sp.	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fabanella boloniensis	..	94	50	41	56	14	43	46	..	2	..	..	3	17	11	1	..	..	..	..	..	2	..	..
Fabanella ansata	..	318	38	71	19	12	32	18	..	2	1	..	9	7	1	..	..	..	2	..	..	..	..	..
Mantelliana purbeckensis	..	..	32	14	4	14	..	..	..	..	1	48	57	32	17	2	..	..	..	1	..	5	98	1
Cypridea tumescens praecursor	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	1	..	..	..	..	..	..	..	..
Cypridea dunkeri	..	..	..	..	..	..	4	6	1	..	..	..	..	9	30	..	..	..	..	..	2	..	..	..
Scabriculocypris trapezoides	..	..	..	..	..	..	..	..	..	1	..	1	..	2	1	1	..	..	..	..	1	..	..	..

The samples were collected from excavations one mile north of Whitchurch on the Buckingham road, also from a field pit a little south of Hurdlesgrove Farm, about one mile north of Whitchurch on the western side of the Buckingham road.

North Whitchurch

		ft.	in.
NWD.	Trench dug into bank beside road.		
35	Sand and slipped material about	5	0
34	Yellow sandy clay		10
33	Tough grey sandy clay		4
32	Yellow sand about	1	6
31	Tough sandy clay		5
30	Soft white marl		6
29	Grey clay		3
28	Yellow sand and clay		10
27	Black clay	1–2	
26	Crumbly white marl and clay	1	2
25	Grey marlstone seen to		6
	Possible gap in section		
NWE.	Pit dug in grass verge		
24	Crumbly white marl		9
23	Marlstone		1
22	Marly and sand clay		8
21	Marlstone and soft marl	2	4
20	Grey sand and clay		5
19	Crumbly hard marlstone, top a mass of gastropod casts		6
NWF.	Pit dug in grass verge a little to the north of NWE.		
18	Thinly laminated grey sand and clay in alternate layers	1	6
17	Black clay		6
16	Mottled red and green clay and marl with oysters		6
15	Brittle marlstone	1	10
14	Hard fine grained limestone or calcite mudstone		11
13	Laminated marl and clay		4
12	Hard brittle marlstone, greenstained down joints		11
11	Soft grey clayey marl	3	0
10	Sandstone		4
9	Loose sand, highly bituminous smell	1	4
8	Shelly clay with boulders and pebbles of limestone		6
7c	Shelly oolite with large lamellibranchs		3
7b	Hard laminated Pendle	1	0
7a	Soft Pendle, alternating layers of marlstone and ostracods (ooliths?)		6
6	Shelly clay		2

HG.	Old quarry in field south of Hurdlesgrove Farm	*ft.*	*in.*
5	Roach, *Trigonia* casts etc.	2	0
4	Soft shaley marl with perished shells and large oysters . .		9
3	Rubbly limestone full of lamellibranch casts	2	6
2	As above but with finer grain and fewer fossils . . .	2	0
1	Sand, seen to	4	0

WARREN HOUSE FARM, STEWKLEY

The old pit to the south of this farm forms the most northerly outcrop of the Portland and Purbeck Beds in England. It is a very small outlier and is probably preserved due to being downfaulted at some time. The section exposed in 1939 is shown below. The quarry is now overgrown and only about three feet of the topmost beds can be seen. It was first described by Fitton (1836) and in 1962 C. R. Bristow and M. J. Hughes were able to expose beds containing large Portland lamellibranchs by means of excavation (Bristow personal communication), i.e. beds 2 and 3 of the section below. Text-fig. 1 shows that marine influence is strong all through the section. The marine ostracod fauna is present throughout but is soon joined first by the euryhaline and then by the oligohaline ostracod faunas.

The earliest appearance of oligohaline ostracods is notable since they are to be found in a bed (WH 7) containing *Trigonia* and *Protocardia* sp. (Nos. 11928–31 in Leicester University Coll). This is the only bed containing a few *Cypridea* sp., the fauna being mainly euryhaline with some marine ostracods. It would appear that some form of mixing had occurred or that seasonal variation in salinity and fauna was possible so that *Cypridea* could live in the same place as the marine ostracods. A surprising feature of the bed WH 7 is its similarity to the Swindon Roach, the difference being in the ostracod faunas. This is the bed referred to by Jones (1885 : 328) as containing *Trigonia* and as being underlain by a cypridiferous marl.

The oligohaline faunas in the rest of the beds do not contain *Cypridea* and form about twenty per cent or less of the whole fauna.

Bed WH 8 is a shelly marl containing *Ostrea expansa* (11926–27 in Leicester University Coll.) and other lamellibranchs together with a dominantly marine ostracod fauna. This is a typical marine deposit.

Beds WH 8, 10, 11 have a dominantly marine ostracod fauna with both euryhaline and oligohaline ostracod species present, whereas Bed WH 9 has a dominantly euryhaline ostracod fauna with a small percentage of marine and oligohaline ostracods. In both cases some form of mixing or seasonal variation in salinity and faunas could have occurred.

The conclusions to be made are as follows :

1. Conditions of deposition were rapidly changing ;
2. The limestones of beds WH 1, 2, 3 can be easily correlated with similar beds at the Bugle Pit and at North Whitchurch. This is facies A. The rest of the

beds can be classed as facies B, but representing a more changeable region possibly a shallow embayment with a river emptying into it. Facies C and D are missing but facies E comes in at the top in the form of bed WH 14.

3. A likely explanation for the mixing of the faunas is the erosion and redeposition of oligohaline and euryhaline ostracods into deposits of marine ostracods.

TABLE III

	1	2	3	4	5	6	7	8	9	10	11	12
Macrodentina (Macrodentina) rugulata	..	2	23	10	25	17	116	89	10	133	190	49
Macrodentina (Macrodentina) transiens		20	..	..	..	16	1	20	3	7	3	20
Macrodentina (Dictocythere) retirugata	..	..	21	..	21	6	..	..	..	6	10	2
Protocythere serpentina	..	..	..	..	..	..	..	..	9	..	..	2	3
"Macrocypris" ? sp.	..	..	..	14	8	5	..	..	..	..	..	..	1
Paraschuleridea buglensis	..	4	..	..	2	8	..	28	..	..	1	11
Orthonotacythere rimosa	..	..	..	..	..	3	..	..	..	..	1	..
Procytheropteron brodiei	..	..	..	2	..	3	..	..	..	..	..	..	..
Wolburgia visceralis	..	..	..	..	..	1	..	..	..	..	..	..	..
Fabanella boloniensis	..	3	1	3	6	35	6	48	41	20	199
Fabanella ansata	..	8	1	4	13	79	18	49	79	19	166
Mantelliana purbeckensis	..	..	..	..	..	..	..	52	65	100	..	..
Cypridea tumescens praecursor	..	..	..	..	..	..	10	..	..	..	..	..
Klieana alata	..	..	..	..	..	..	..	..	6	4	12	4
Scabriculocypris trapezoides	..	..	..	..	..	..	44	..	25	28	..	..

Warren House Farm, Stewkley

WH.		ft.	in.
	Quarry to the south of the farm house		
14	Red subsoil	1	0
13	Grey marl		2
12	Crumbly white and grey marl	3	0
11	Shaley marl with layers of ostracods		6
10	Grey marl		9
9	White laminated marl with ostracods and disseminated vegetation specks	1	6
8	Crumbly shelly marl, *Ostrea expansa* and medium sized lamellibranchs		4
7	Marlstone with *Trigonia* and *Protocardia*	1	0
6	Grey marl, ostracods abundant		9
5	Shaley shelly marl with large oysters		7
4	Shelly limestone with *Trigonia* etc.		5–7
3	Shaley shelly marl with large oysters		4
2	Rubbly limestone with *Trigonia, Protocardia, Pecten, Exogyra* spp., etc.	4	9
1	Sand, seen to	9	6

SUMMARY OF RESULTS

The major marker horizon in all three sections is the Crendon Sand at the base. Above this are the Creamy Limestones with large lamellibranchs and ammonites, some of which Buckman (1923 : 24, 26), had described from localities nearby. The ammonites from the topmost beds in the Long Crendon area were considered by Buckman to be younger than any from the Dorset coast. This marine facies is followed by facies B, C and D as indicated earlier, especially in the Bugle Pit and at North Whitchurch. At Warren House Farm conditions have changed; facies C and D are missing and facies B modified to take their place.

An examination of the ostracods shown in the Text-figure indicates that the euryhaline forms *Fabanella boloniensis* and *Fabanella ansata* are present in facies B, C and D. On the Dorset coast *Fabanella boloniensis* and *Mantelliana purbeckensis* are to be found in supersaline conditions (Anderson 1958).

Since the ostracods *Fabanella ansata* and *Mantelliana purbeckensis* are characteristic of the Lower Purbeck Beds of Dorset and as they appear in the upper part of the Creamy Limestones of the Aylesbury district, it would appear that Lower Purbeck conditions had set in before the end of Portland times in the Aylesbury district (cf. Casey & Bristow 1963 : 4).

No evidence has been found of Middle or Upper Purbeck ostracods in these sections but Middle Purbeck lamellibranchs have been obtained from the so-called Wealden Beds above the Purbecks of this region, (Casey & Bristow 1963, 1964).

In conclusion it can be stated that the transition from Portland to Purbeck conditions is marked by a series of facies which can be recognized by means of lithology, macrofauna and ostracods.

SYSTEMATIC DESCRIPTIONS

Suborder PODOCOPINA Sars 1866

Superfamily **CYPRIDACEA**

Family **CYPRIDIDAE**

Subfamily **CYPRIDINAE** Baird 1845

Genus ***MANTELLIANA*** Anderson

Mantelliana purbeckensis (Forbes)

(Pl. 7, fig. 5)

For complete synonymy see Anderson p. 438.

MATERIAL. Two hundred and thirty-nine valves and carapaces from the Bugle Pit (see Table I). Three hundred and twenty-six valves and carapaces from North Whitchurch (see Table II). Two hundred and seventeen valves and carapaces from Warren House Farm, Stewkley (see Table III). Other specimens were also obtained from similar horizons at Haddenham and Towersey.

REMARKS. This species is believed to be euryhaline in the Aylesbury district. It is seldom well preserved but muscle scars have been seen and cross-sections through the shell have indicated the size and shape of the duplicature and vestibule (see Barker in press).

Subfamily **ILYOCYPRIDINAE** Kaufman 1960

Genus ***RHINOCYPRIS*** Anderson 1941

Rhinocypris jurassica (Martin)

(Pl. 7, figs. 17, 18)

1940 *Ilyocypris jurassica jurassica* Martin : 312, pl. 4, figs. 51–54.
1941 *Rhinocypris scabra* var. *hamata* Anderson : 378, pl. 19, fig. 19.
1963 *Rhinocypris jurassica jurassica* (Martin) Oertli : 18, pl. 5, figs. 25–27.

Material. Six valves from Bed 16 at the Bugle Pit.

Description. Carapace thin shelled with a sub-elliptical lateral outline. The anterior margin is slightly larger than the posterior and both are evenly and smoothly curved. Dorsal margin slightly convex, ventral margin slightly concave. Greatest height midway between centre and anterior. The left valve overreaches the right valve around the free margin but not along the dorsal margin.

Shell surface covered by many small pustules closely arranged and of uniform size. Three major spines or hollow tubercles are present near the dorsal margin, separated by two transverse grooves, one medially from the dorsal margin to the centre of the valve and another smaller groove to anterior of this. There are about six to eight smaller spines of more or less equal size situated mainly posterior to the large anterior spine. Those nearer the posterior dorsal margin are curved to the rear. Hinge adont. The line of concrescence is parallel to and a short distance from the outer margin, a slight vestibule around the anterior border and at the posterior ventral corner being formed.

Muscles scars seen internally on a central node but not distinguishable. Normal and radial pore canals not clearly seen.

Remarks. Mandelstam (1956) has described what appears to be the same genus under the name *Origoilyocypris*. The specimen figured by Oertli (1963) as *Rhinocypris jurassica jurassica* is much smoother and not so spinose as the specimens described here.

Subfamily **CYPRIDEINAE**

Genus ***CYPRIDEA*** Bosquet 1952

Cypridea dunkeri Jones

(Pl. 7, figs. 1, 2)

1885 *Cypridea dunkeri* Jones: 339, pl. 8, figs. 9, 10, 17.
1941 *Ulwellia papulata* Anderson : 381, pl. 18, fig. 8.
1963 *Cypridea dunkeri* Jones ; Oertli : 15, pl. 1, fig. 6.

Material. Six valves and carapaces from the Bugle Pit (see Table I). Five valves and carapaces from North Whitchurch (see Table II). One carapace from Haddenham.

Remarks. *Cypridea dunkeri* is characteristic of the oligohaline facies but few specimens are usually found.

Cypridea tumescens (Anderson) *praecursor* Oertli

(Pl. 7, fig. 4)

1940 *Cypridea valdensis* (Fitton) ; Martin : 288, pl. 1, figs. 1–4.
1939 *Cyamocypris tumescens* Anderson : 306, pl. 13, figs. 4, 7.
1963 *Cypridea valdensis praecursor* Oertli : 16, pl. 3, figs. 13–19, pl. 4, fig. 20.

Material. Forty-five valves and carapaces from the Bugle Pit (see Table I). Forty-one valves and carapaces from North Whitchurch (see Table II). Ten valves and carapaces from Bed 7 at Warren House Farm, Stewkley. Eighty-three valves and carapaces from similar beds at Haddenham, and thirty-four specimens at Towesey.

	Dimensions in mm.			Proportions			
	L	H	I	L	H	I	Specimen Number
Carapace . .	1·17	0·71	0·51	1·00	0·61	0·44	Io. 1223
Left valve . .	1·17	0·73	—	1·00	0·62	—	Io. 1224
Right valve . .	1·02	0·61	—	1·00	0·60	—	Io. 1225

Remarks. This species is characteristic of the oligohaline facies. Specimens are few and some are broken. There is variation in lateral outline as suggested by Oertli (1963). Specimens from other horizons in the Purbeck Beds show a wide variation in shape (cf. those figured by Anderson) but all the specimens probably belong to the same group.

Family **PARACYPRIDIDAE** Sars 1923

Genus ***PARACYPRIS*** Sars

Paracypris? sp.

(Pl. 9, figs. 9, 10)

Material. Four carapaces from Bed NW 5 at North Whitchurch (see Table II). Two hundred and sixty-eight carapaces from various beds at Haddenham of similar age to the North Whitchurch material.

Description. Characteristic elongate shape with the greatest height just anterior of the centre. The dorsal margin is short and straight or obliquely convex. The ventral margin is longer and concave. Anterior margin is obliquely curved, sharpest towards the venter. Carapace smooth on external surface.

The internal details have not been seen but in some specimens there are faint indications of elongate muscle scars in a vertical row of four at the position of greatest height.

Remarks. This form shows many similarities in shape to *Paracypris* although not definitely identified as such at the present time.

Superfamily **DARWINULACEA** Brady & Norman 1889

Family **DARWINULIDAE** Brady & Norman 1889

Genus ***DARWINULA*** Brady & Robertson 1885

Darwinula leguminella (Forbes)

(Pl. 7, fig. 9)

1855 *Cypris leguminella* Forbes *in* Lyell : 294, text-fig. 334*c*.
1885 *Darwinula leguminella* (Forbes) Jones : 346, pl. 8, figs. 80, 31.
1885 *Cyprione Bristovii* Jones : 344, pl. 8, figs. 27–29, 32.

Remarks. A rare species in the Aylesbury district.

Superfamily **CYTHERACEA** Baird 1850

Family **CYTHERIDAE** Baird 1850

Genus ***FABANELLA*** Martin 1961

Fabanella boloniensis (Jones)[1]

(Pl. 7, fig. 7)

1882 *Cythere boloniensis* Jones: 615–616, text-figs. A, B.
1883 *Cythere ? boloniensis* Jones; Jones: 58, text-figs. 1–9.
1885 *Candona boloniensis* (Jones) Jones: 348, pl. 9, figs. 7, 8.
1940 *Cyprideis polita* Martin : 352, pl. 7, figs. 110–113, pl. 9, figs. 149–151.
1961*a* *Fabanella polita* (Martin) Martin : 186, 190–192, pl. 1, figs. 1–4, 10–12.
1961*b* *Fabanella polita polita* (Martin) ; Martin : 113, pl. 14, fig. 9.
1963 *Fabanella polita polita* (Martin) ; Oertli : 21, pl. 7, figs. 46–52.

Material. Five hundred and six valves and carapaces from various beds at the Bugle Pit (see Table I). Three hundred and eighty valves and carapaces from various beds at North Whitchurch, (see Table II). Three hundred and sixty-two valves and carapaces from various beds at Warren House Farm, Stewkley, (see Table III). Beds of similar age have yielded three hundred and eighty-eight valves and carapaces at Haddenham, ninety-nine valves and carapaces at Towesey and seven valves and carapaces at Coneyhill.

Remarks. In the Aylesbury district *Fabanella boloniensis* has been shown to be a euryhaline ostracod capable of existing in various environments (Barker 1963). It is smallest in the oligohaline facies and largest in the marine facies.

Fabanella ansata (Jones)

(Pl. 7, fig. 8)

1885 *Candona ansata* Jones : 349, pl. 9, figs. 9–12.
1947 *Candona ansata* Jones ; Anderson *in* Arkell : 129, text-fig. 28 (9).
1963 *Fabanella ansata* (Jones) Oertli : 22, pl. 16, figs. 43–45.

Material. Nine hundred and fifty-five valves and carapaces from various beds at the Bugle Pit (see Table I). Five hundred and thirty valves and carapaces from

[1] Anderson & Barker consider *Fabanella polita* (Martin) to be a synonym of *Fabonella boloniensis* (Jones). They propose a fuller discussion of this species elsewhere.

various beds at North Whitchurch, (see Table II). Four hundred and thirty-six valves and carapaces from various beds at Warren House Farm, Stewkley, (see Table III). Beds of similar age have yielded five hundred and ten valves and carapaces at Haddenham, one hundred and eighty valves and carapaces at Towersey and seven at Coneyhill.

Description. The lateral outline is subreniform with the greatest height towards the posterior and the greatest inflation central. Anterior and posterior margins obliquely curved, slightly sharper towards the venter. Ventral margin concave and slightly inturned. Dorsal margin slightly inturned and more or less straight. In dorsal view carapace is acutely elliptical. Left valve is larger than and overreaches the right valve. External surface smooth with a few normal pore canals irregularly spaced. Radial pore canals numerous, fine straight and closely spaced around the anterior, posterior and ventral borders. Adductor muscle scars in a vertical row of four just anterior of centre. Frontal scars situated to anterior of adductors opposite the top and bottom scars. In some specimens a small fifth scar can be seen above and in line with the four adductors ; this may be the " fulcral point " (Van Morkhoven 1962 : 48) rather than a muscle scar. Hinge lophodont. A small anterior vestibule widest antero-ventrally and a narrow posterior vestibule parallel to the outer margin.

	Dimensions in mm.			Proportions			
	L	H	I	L	H	I	Specimen Number
Carapace . .	1·17	0·73	0·59	1·00	0·63	0·50	..
Left valve . .	1·00	0·73	—	1·00	0·73	—	..
Right valve . .	0·95	0·56	—	1·00	0·59	—	..
Carapace . .	0·96	0·62	0·50	1·00	0·65	0·52	In. 48669

Remarks. This species is characteristic of euryhaline conditions in the Aylesbury district and varies in size according to the salinity. It is smallest in the oligohaline facies and largest in the marine facies (Barker 1963).

Family **CYTHERIDEIDAE** Sars 1925

Subfamily **CYTHERIDEINAE** Sars 1925

Genus ***GALLIAECYTHERIDEA*** Oertli 1957

Galliaecytheridea crendonensis sp. nov.

(Pl. 8, figs. 7–11)

Holotype. Io. 1257, carapace from Bed CWE 2, Long Crendon. Length 0·68 mm., height 0·39 mm., inflation 0·31 mm.

Paratypes. Io. 1258–59 from Bed CWE 2, Long Crendon.

DIAGNOSIS. *Galliaecyatheridea* with pronounced caudal process.

MATERIAL. Six valves from Bed CWE 2 and one valve from Bed CWE 3 at Long Crendon. Also six valves from Bed CH 8 and one valve from Bed CH 7 at Coneyhill.

DESCRIPTION. Carapace asymmetrically subelliptical in lateral outline. Right valve with a pronounced caudal process. Dorsal of the right valve more or less straight, converging posteriorly with the ventral margin. Anterior margin obliquely curved, sharper towards the venter. Left valve has a more rounded outline with a very much reduced and rounded caudal process. Dorsal margin more or less straight, converging towards the posterior. Ventral margin convex. Anterior margin smoothly and obliquely curved, slightly sharper towards the venter. Greatest height at the centre. In dorsal view the outline is elliptical with the greatest inflation in the centre. The left valve is greater in height than the right, but the right valve is greater in length due to the caudal process.

The outer surface is ornamented by irregularly spaced and sized pits, the larger usually being near the centre. In both valves there is a slight furrow just behind the anterior margin. Line of concrescence and inner margin coincide throughout. The selvage forms the outer margin all round except anteriorly in the right valve where it runs a short distance inside the outer margin. Pore canals not seen. Hinge hemimerodont, consisting of two terminal teeth subdivided into six or seven toothlets and connected by a smooth narrow groove in the right valve. The left valve has complementary elements and also an accommodation groove behind the median ridge. There are four adductor muscle scars in a vertical row slightly concave to the anterior. A frontal scar is situated opposite the top adductor and a rather large mandible scar, possibly made up of two scars, somewhat below and anterior to the bottom adductor.

REMARKS. Sexual dimorphism has not been observed in this species. The shape of the posterior is characteristic of the species. So far it has only been found at Long Crendon and Coneyhill.

Family **BRACHYCYTHERIDAE** Puri 1954

Genus ***MACRODENTINA*** Martin 1940

REMARKS. Sylvester-Bradley (1956) considered the genus *Dictyocythere* (Jones) to consist of two subgenera, *Dictyocythere* and *Rhysocythere*, differentiated on the basis of hinge structure. However, Malz (1958) showed that *Rhysocythere* is a junior synonym of Martin's genus *Macrodentina*, and subdivided this genus into three subgenera on the basis of hinge structure, *Macrodentina* ss. *Macrodentina* (*Dictyocythere*) and *Macrodentina* (*Polydentina*). The differences between the three subgenera of Malz were considered to be strong enough to raise them to full generic level in Volume Q of the *Treatise on Invertebrate Palaeontology*. In the present work the differences between the subgenera are thought to be insufficient to give them full generic status and the classification of Malz is followed.

Subgenus *MACRODENTINA* Martin 1940

Macrodentina (Macrodentina) rugulata (Jones)

(Pl. 8, figs. 16, 17)

1885 *Cythere retirugata* var. *rugulata* Jones : 350, pl. 9, figs. 17–20.
1940 *Cythere retirugata* Jones var. *rugulata* Jones ; Anderson : 373, pl. 18, fig. 1.
1956 *Dictyocythere* (*Rhysocythere*) *rugulata* (Jones) Sylvester-Bradley : 18, pl. 4, figs. 1, 2, 5–15.
1958 *Macrodentina* (*Macrodentina*) *rugulata* (Jones) Malz : 18, pl. 6, figs. 83–86.

MATERIAL. Six hundred and six valves and carapaces from various beds at the Bugle Pit (see Table I). Two hundred and ninety-seven valves and carapaces from various beds at North Whitchurch (see Table II). Five hundred and sixty-four valves and carapaces from various beds at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded one hundred and thirteen valves and carapaces at Haddenham, ten valves at Towesey and twenty valves and carapaces at Coneyhill.

DESCRIPTION. Carapace subtrapezoidal in lateral outline with greatest height to the anterior of centre. Dorsal view inflated elliptical with the greatest inflation medially and towards the venter. Ventral surface has about eight subparallel longitudinal ridges. The dorsal and ventral margins are convex outwards. Anterior and posterior margins obliquely rounded, sharper towards the venter. The left valve is larger than the right.

Lateral surfaces smooth except near the ventral margins where there are three long ridges similar to those on the ventral surface but decreasing in length towards the centre of the valve. Normal pore canals regularly spaced over the carapace. Radial pore canals straight, about twenty being irregularly spaced around the anterior border and very few on the posterior border. Four adductor muscle scars in a vertical row of four just anterior of the valve centre. Hinge paramphidont. Line of concrescence parallel to the outer margin except at the anterior ventral corner where it forms a slight vestibule.

	Dimensions in mm.			Proportions			
	L	H	I	L	H	I	Specimen Number
Carapace ♀	0·83	0·54	0·49	1·00	0·65	0·59	Io. 1236
Left valve ♂	0·95	0·56	—	1·00	0·59	—	..
Left valve ♀	0·88	0·56	—	1·00	0·64	—	Io. 1237
Right valve ♀	0·83	0·54	—	1·00	0·65	—	Io. 1238
Right valve ♂	0·90	0·51	—	1·00	0·57	—	..
Carapace ♂	0·96	0·58	0·54	1·00	0·60	0·56	I. 1655
Left valve ♂	0·88	0·58	—	1·00	0·66	—	I. 1670
Carapace ♀	0·78	0·48	0·45	1·00	0·62	0·58	GSM, No. 70338

REMARKS. A common easily recognized species in the Aylesbury district.

Macrodentina (Macrodentina) transiens (Jones)

(Pl. 8, figs. 1–6)

1885 *Cythere transiens* Jones : 349, pl. 9, figs. 13–16.
1956 *Dictyocythere* (*Rhysocythere*) *transiens* (Jones) Sylvester-Bradley : 19, pl. 3, figs. 11–13.
1958 *Macrodentina* (*Macrodentina*) *transiens* (Jones) Malz : 17, pl. 6, figs. 81, 82.

Diagnosis. Small reticulate *Macrodentina* tapering strongly to the posterior in lateral view. No sexual dimorphism.

Material. Four hundred and eighty three valves and carapaces from various beds at the Bugle Pit (see Table I). One hundred and fourteen valves and carapaces from various beds at North Whitchurch (see Table II). Ninety valves and carapaces from various beds at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded forty two valves and carapaces at Towersey, three hundred and fifty-seven valves and carapaces at Long Crendon and two hundred and twenty valves and carapaces at Coneyhill.

Description. Broadly ovate asymmetrical lateral outline, greatest height being anterior of the centre. In dorsal view the sides are subparallel and the ends rounded, the posterior being more pointed. Dorsal margin straight or very slightly convex and slopes down towards the posterior. Ventral margin slightly convex, the ventral surface being slightly ridged longitudinally. The anterior margin is more broadly rounded than the posterior.

Shell surface strongly pitted. The pits arranged in rows near the margins but more irregularly situated towards the centre. On the left valve there is a small posteriorly directed spine at the posterior ventral corner. Normal pore canals are situated in a pit. Radial pore canals are present not difficult to distinguish. Four adductor muscle scars are situated in a vertical row about the centre of the valves. Hinge paramphidont.

	Dimensions in mm.			Proportions			
	L	H	I	L	H	I	Specimen Number
Carapace .	0·61	0·37	0·32	1·00	0·61	0·52	..
Carapace .	0·59	0·37	0·32	1·00	0·63	0·49	Io. 1239
Right valve .	0·61	0·32	—	1·00	0·52	—	Io. 1241
Left valve .	0·59	0·37	—	1·00	0·63	—	Io. 1240

Remarks. This species is smaller than and easily distinguished from the other species of *Macrodentina* by means of its shape.

Subgenus ***DICTYOCYTHERE*** Sylvester-Bradley 1956

Macrodentina (Dictyocythere) retirugata (Jones)

(Pl. 8, figs. 18–22)

1885 *Cythere retirugata* Jones : 350, pl. 9, figs. 21–23.
1885 *Cythere retirugata* var. *textilis* Jones : 350, pl. 9, fig. 24.
1941 *Cythere retirugata* Jones var. *textilis* Jones ; Anderson : 374, pl. 18. fig. 3.
1941 *Cythere retirugata* Jones var. *decorata* Anderson : 374, pl. 18, fig. 4.

1956 *Dictyocythere* (*Dictyocythere*) *retirugata* (Jones) Sylvester-Bradley : 15, pl. 3, figs. 7–10, pl. 4, figs. 3, 4, 11, 16, 17.
1956 *Dictyocythere* (*Dictyocythere*) *decorata* (Anderson) Sylvester-Bradley : pl. 17, pl. 3, fig. 1.
1958 *Macrodentina* (*Dictyocythere*) *retirugata* (Jones) Malz : 25, pl. 6, figs. 87, 88.
1958 *Macrodentina* (*Dictyocythere*) *textilis* (Jones) Malz : 26, pl. 6, figs. 89–91.

Material. Five hundred and twenty-seven valves and carapaces from various beds at the Bugle Pit (see Table I). Two hundred and sixty-three valves and carapaces from various beds at North Whitchurch (see Table II). Sixty-six valves and carapaces from various beds at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded six valves at Coneyhill.

Description. Lateral outline subtrapezoidal with greatest height to anterior of centre. Pyriform in dorsal view with greatest inflation towards the posterior. The dorsal margin is straight and the ventral margin is sinuous, slightly concave medially. Anterior margin smoothly and obliquely rounded, sharper towards the venter. Posterior margin smaller and almost straight forming a posterior dorsal slope. The inflation is greatest towards the venter so that the ventral surface is almost flat with about six rows of elongate reticulae more or less parallel to its length.

The surface is strongly reticulate, the reticulation arranged in rows parallel to the margins near the venter, posterior and anterior but irregularly elsewhere. Normal pore canals large, situated in each cell of the reticulum. Inside these polygonal areas fine " second order " reticulations can often be seen. In some specimens the reticulation has been smoothed out to form circular rather than polygonal pits, leaving faint indications for the fine reticulations in some places. The radial pore canals are sparse and straight, with about twelve to the anterior border and eight to the posterior. Four adductor muscle scars are in a vertical row just posterior of the position of greatest height. A single frontal scar is situated in line with the second dorsal adductor. Hinge holamphidont. Line of concrescence not clear but there are vestibules around the anterior and at the posterior ventral corner. The right valve overlaps the left around the anterior half of the carapace and the left valve overlaps the right around the posterior half of the carapace.

Remarks. The variation in ornamentation of this species is so continuous when a large number of specimens are examined that it is impossible to separate the three morphological types shown in Pl. 8.

Family **CYTHERURIDAE** Müller 1894

Genus ***PROCYTHEROPTERON*** Ljubimova 1955

Procytheropteron brodiei (Jones)

(Pl. 8, figs. 23–26, Pl. 9, fig. 8)

1894 *Cytheropteron brodiei* Jones : 167, pl. 9, fig. 12.
1964 *Procytheropteron brodiei* (Jones) Anderson: 154, pl. 11, figs. 41, 42.

Material. Two hundred and thirty-five valves and carapaces from various beds at the Bugle Pit (see Table I). Seventy-two valves and carapaces from various beds

at North Whitchurch (see Table II). Five valves from beds four and six at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded ten valves and carapaces at Haddenham, and two valves at Long Grendon.

Description. Carapace smooth and glossy with a sub-circular lateral outline drawn out slightly to posterior, and with the greatest height to the anterior. Swollen in dorsal view with the greatest inflation centrally situated. Anterior margin is obliquely curved, sharpest towards the venter. Posterior margin is drawn out in a projection. Both valves are swollen near the ventral margins and form an angle with the concave ventral surface which is ornamented with three or four longitudinal subparallel ridges to each valve.

Ornamentation consists of faint longitudinal reticulations on the lateral surfaces. Normal pore canals are regularly distributed. Anterior border has about seven straight radial pore canals.

Line of concrescence and inner margin coincide. Hinge hemimerodont. Four poorly distinguished adductor muscle scars are in a vertical row just anterior of the centre. Outer margin forms a lip centrally on the ventral margin. Posterior projection is slightly hollow so forms a slight tube with the opposite valve.

	Dimensions in mm.			Proportions		
	L	H	I	L	H	I
Carapace	0·48	0·29	0·29	1.00	0·60	0·60
Left valve	0·47	0·29	—	1.00	0·62	—

Remarks. This species differs from those of *Cytheropteron* by having a smooth median portion to the hinge and a more rounded lateral outline.

Genus ***ORTHONOTACYTHERE*** Alexander 1933

Orthonotacythere rimosa Martin

(Pl. 8, figs. 12, 13)

1940 *Orthonotacythere rimosa* Martin : 335, pl. 6, figs. 84–86.
1961 *Orthonotacythere rimosa* Martin ; Martin : 117, pl. 14, fig. 21*a–c*.

Material. Seventy-eight valves and carapaces from various beds at the Bugle Pit (see Table I). Four valves from beds 6 and 11 at Warren House Farm, Stewkley (see Table III).

Description. Subtrapezoidal in lateral outline with the dorsal and ventral margins subparallel. Greatest height and greatest inflation are posterior of centre. Anterior margin is obliquely rounded sharper to venter ; posterior margin subtriangular forming a caudal process to the posterior corner. Ventral margin slightly convex ; dorsal margin long and straight.

The ornamentation consists of an irregular reticulate rib pattern with a few strong ridges radiating from the ventral margin just posterior of the centre where the inflation is greatest. The major ridge is inside but more or less parallel to the anterior,

ventral and posterior margins. A few short radial pore canals are to be seen at the anterior and posterior margins. The muscle scars are not clear. Inner margin and line of concrescence coincide.

	Dimensions in mm.			Proportions			
	L	H	I	L	H	I	Specimen Number
Carapace . .	0·59	0·39	0·32	1·00	0·58	0·54	Io. 1242
Right valve . .	0·73	0·39	—	1·00	0·53	—	Io. 1244
Left valve . .	0·66	0·37	—	1·00	0·56	—	Io. 1243

Remarks. The rib pattern appears to be slightly stronger than the figured specimens of Martin (1940), but since the specimens described here are larger they may represent a later instar.

O. rimosa differs from *O. diglypta* Triebel by having weaker ornamentation and a straight dorsal margin. The sulcus is not so deep in *O. rimosa* as it is in *O. interrupta.*

Family **LIMNOCYTHERIDAE** Klie 1938

Genus ***DICRORYGMA*** Poag 1962

Dicrorygma fragilis (Martin)

(Pl. 7, figs. 19, 20)

1940 *Limnocythere fragilis* Martin : 348, pl. 7, figs. 105–109, pl. 9, fig. 152.

Material. Six valves from Bed BP 16 at the Bugle Pit, (see Table I).

Description. Valves thin and fragile, subreniform in lateral outline. Dorsal margin straight, ventral margin longer but sinuous. Anterior and posterior obliquely rounded, the posterior being the larger, and both are slightly compressed near the margins. Shell surface smooth. A subcentral sulcus occurs near the venter just posterior of the centre and another vey faint one near to the dorsal margin just above the muscle scars. Normal pore canals few in number, sieve type and irregularly distributed. There are about ten radial pore canals to the posterior margin and fewer to the anterior. They are fairly straight and irregularly spaced. Hinge is weakly developed lophodont. Four adductor muscle scars are arranged in a slight curve concave to the anterior just in front of the centre. A frontal scar occurs opposite to the top adductor with possibly a fulcral point just below it. Two mandibular scars are arranged antero ventrally to the adductors. The line of concrescence runs parallel to the outer margin and a short distance inside it forming a vestibule to the anterior and posterior ventral borders.

Remarks. Very few specimens are to be found in this region.

Dicrorygma decipiens (Anderson)

(Pl. 7, figs. 15, 16)

1941 *Cytherella ? decipiens* Anderson : 380, pl. 19, figs. 20, 21.

Material. Three valves from Bed 16 at the Bugle Pit (see Table I).

DESCRIPTION. Thin fragile valves are subreniform in lateral outline. The dorsal margin and the ventral longer and concave medially. Posterior is larger and more obliquely rounded than the anterior and both are slightly flattened round the margins. Surfaces of the valves are covered by numerous discontinuous ridges more or less parallel to the outer margins. There is a slight subcentral sulcus just posterior of the centre and a much fainter one near the dorsal margin just above the muscle scars. A few normal pore canals of the sieve type are distributed irregularly. About ten fairly straight and irregularly spaced radial pore canals are in the posterior margin and fewer in the anterior. Hinge is lophodont. Four adductor muscle scars are in slight curve, concave to the anterior, and situated just anterior of the valve centre. There is also a frontal scar and two mandibular scars though they are difficult to see because of the ornament. The line of concrescence runs parallel to the outer margin and a short distance inside it forming a vestibule to the anterior and posterior ventral borders.

REMARKS. *Dicrorygma decipiens* is easily distinguished from *D. fragilis* by means of its lateral outline and its distinctive ornamentation. This species is very rare.

Genus ***THERIOSYNOECUM*** Branson 1933

Theriosynoecum forbesii (Jones)

(Pl. 7, fig. 6, Pl. 9, figs. 11, 12)

1885 *Metacypris forbesii* Jones : 344, pl. 8, figs. 11–16.
1940 *Metacypris forbesii* Jones ; Martin : 336, pl. 6, figs. 89–94.
1957 *Gomphocythere forbesii forbesii* (Jones) Wicher : 270.
1962 *Bisulcocypris forbesii* (Jones) Pinto & Sanguinetti : 39, pl. 3, figs. 1–4, pl. 12, figs. 1*a–d*.

MATERIAL. Five carapaces and six valves from Bed TW 2 at Towersey. Twenty-seven carapaces and thirty-one valves from Bed HDB la at Haddenham.

REMARKS. According to Pinto & Sanguinetti (1962) *Theriosynoecum* differs from *Bisulcocypris* in having a less well-defined hinge, accommodation groove and velate ridges. The species considered here has no accommodation groove but otherwise corresponds to *Theriosynoecum*. Plate 9, figs. 11, 12, show the wide variation in ornamentation of *Theriosynoecum forbesii* which approaches that of *Bisulcocypris verrucosa* (Jones) described by Pinto & Sanguinetti. (See discussion by Sohn & Anderson 1964).

Family **PROGONOCYTHERIDAE** Sylvester-Bradley 1948

Subfamily **PROTOCYTHERINAE** Ljubimova 1955

Genus ***KLIEANA*** Martin 1940

Klieana alata Martin

(Pl. 7, figs. 10–14)

1940 *Klieana alata* Martin : 322, pl. 5, figs. 64–73 ; pl. 11, figs. 158–161.
1963 *Klieana alata* Martin ; Oertli : 22, pl. 7. figs. 53–56.

DIAGNOSIS. A *Klieana* with almost reticulate pitting and distinct sexual dimorphism.

HOLOTYPE. Senckenberg Museum Nr. X/E 319, female carapace.

MATERIAL. Five hundred and ninety-two valves and carapaces from various beds at the Bugle Pit (see Table I). Seventy valves and carapaces from various beds at North Whitchurch (see Table II). Twenty-six valves and carapaces from various beds at Warren Farm, Stewkley (see Table III). Beds of similar age have yielded three hundred and thirty valves and carapaces at Haddenham and two hundred and sixty-five valves and carapaces at Towersey.

DESCRIPTION. *Females:* lateral outline subdeltoidal with the greatest height anterior of the centre. Dorsal outline similar to a broad arrow head with the greatest inflation to the posterior of centre. Anterior margin slightly swollen, smooth and obliquely rounded, sharpest to venter. The posterior margin is similar but not so swollen. A strongly developed posteriorly directed winglike process near the ventral margin is smooth and shiny showing only faint relics of pitting. Ventral surface flat with four subparallel longitudinal ridges to each valve. The dorsal margin is slightly convex. Left valve larger than right. *Males:* Dorsal outline irregularly elliptical with the greatest inflation to the posterior of the centre. Both anterior and posterior margins are slightly swollen, smooth and obliquely curved, sharpest to the venter. The flat ventral surface has four subparallel longitudinal ridges to each valve. Dorsal margin is slightly concave and the left valve is larger than the right.

Both the males and females have the lateral surfaces covered by small pits, almost reticulate in pattern in the case of the female but much finer in the male. There are about six straight evenly spaced radial pore canals to the anterior border and three similarly to the posterior. Four muscle scars are placed centrally in a vertical row slightly concave to the anterior. Hinge hemimerodont. Line of concrescence follows the inner margin all round and the selvage forms the principle ridge round the contact margin, forming a strong lip medially on the female venter and just posteriorly on the male venter.

	Dimensions in mm.			Proportions			
	L	H	I	L	H	I	Specimen Number
Carapace ♀ .	0·56	0·39	0·37	1·00	0·70	0·66	Io. 1245
Carapace ♂ .	0·71	0·39	0·34	1·00	0·55	0·48	Io. 1248
Right valve ♀	0·59	0·37	—	1·00	0·63	—	Io. 1247
Left valve ♀ .	0·59	0·41	—	1·00	0·69	—	Io. 1246
Right valve ♂	0·76	0·39	—	1·00	0·51	—	Io. 1250
Left valve ♂ .	0·69	0·37	—	1·00	0·54	—	Io. 1249

REMARKS. These specimens show the characteristic features of *Klieana alata*, but occasionally there is some variation in ornamentation. In some specimens the posteriorly directed wing-like process is reduced so that the valve becomes almost smoothly rounded. There may also be some reduction in the strength of the pitting which is often reduced or lost completely near the margins of the specimens.

Genus *PROTOCYTHERE* Triebel 1938

Protocythere serpentina (Anderson)

(Pl. 9, figs. 13–18)

1941 *Cythereis serpentina* Anderson : 375, pl. 19, fig. 12.
1951 *Protocythere sigmoidea* Steghaus : 219, pl. 15, figs. 42–45.
1958 *Protocythere bireticulata* Malz : 39, pl. 11, fig. 69.
1960 *Protocythere sigmoidea* Steghaus ; Fernet : 21, pl. 11, figs. 11–13.
1963 *Protocythere serpentina* (Anderson) Oertli : 22, pl. 7, fig. 57.

MATERIAL. Four hundred and fifty-five valves and carapaces from various beds at the Bugle Pit (see Table I). Eighty valves and carapaces from various beds at North Whitchurch (see Table II). Fourteen valves and carapaces from various beds at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded twenty-three valves and carapaces at Haddenham, seventy-eight valves and carapaces at Towersey, three hundred and thirty-eight valves and carapaces at Coneyhill.

DESCRIPTION. Carapace subrectangular in outline with dorsal and ventral margins almost parallel. Anterior margin broadly rounded and denticulate on the inner edge. Posterior margin angular with the ventral part denticulate. The ventral margin is more or less straight whereas the dorsal margin is straight with a dorsal bulge forming a prominent anterior hinge ear or eye tubercle. Left valve is larger than right.

Major ornamentation consists of two ribs, one parallel to the dorsal margin, the other parallel to the ventral margin. A third rib runs from the posterior dorsal corner to the anterior ventral corner just before which it usually swells to form a node. The ribs make a continuous Z shape on the lateral surface and are usually roughly rounded and increase in size from dorsal to ventral. Anterior margin well rounded and inflated. Shell surface is usually covered by fine reticulations. There are occasional small tubercles in various positions. The strength and variation in shape and ornamentation is shown in Pl. 9. The normal pore canals are not seen. There are about thirteen radial pore canals around the anterior border associated with the denticles and also about fifteen radial pore canals on the posterior ventral margin associated with denticles. Adductor scars in a vertical row of four situated on the posterior side of a pit in the anterior part of the shell. Hinge hemimerodont. Line of concrescence follows the inner margin all round.

REMARKS. *Protocythere serpentina* has been described by Oertli (1963) from Middle Kimmeridge to Lower Purbeck Beds in Villemoyenne 2. *P. bireticulata* was described from twelve metres below Purbeck ostracods in the Ile d'Oleron by Malz (1958). *P. sigmoidea* was described from the Kimmeridge 3*a* of Fuhrberg by Steghaus (1951). In England *P. serpentina* has so far only been described from the uppermost Portland beds.

A single population of the present species exhibits all the variations described for the species mentioned above (see Pl. 9, fig. 13). As a consequence all are considered to be conspecific.

Genus ***PARASCHULERIDEA*** Swartz & Swain 1946

Paraschuleridea buglensis sp. nov.

(Pl. 9, figs. 5–7)

1941 *Cytheridea politula* Jones & Sherborn ; Anderson : 375, pl. 19, fig. 14.

DIAGNOSIS. Elliptical in dorsal outline with subreniform lateral outline. Hinge antimerodont. Outer surface smooth with left valve larger than and overreaching the right all round.

HOLOTYPE. GSM Mik (M) 724001. Figured Anderson (1941, pl. 19, fig. 14).

PARATYPES. Il. 1227–29, from bed BP 6*a*, Bugle Pit, Hartwell.

MATERIAL. Two hundred and fifty-seven valves and carapaces from various beds at the bugle Pit (see Table I). Two hundred and fifty-four valves and carapaces from various beds at North Whitchurch (see Table II). Fifty-four valves and carapaces from various beds at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded fifty-six valves and carapaces at Haddenham, fifty-five valves and carapaces at Towersey, one hundred and fifty-six valves and carapaces at Long Crendon and eighty-nine valves and carapaces at Coneyhill.

REMARKS. A robust carapace, reniform in lateral outline and characteristic of the marine faies in the Aylesbury district. It is placed in the genus *Paraschuleridea* because of the similarity in the hinge and muscle scar pattern to the type species. However, the shape is even more smoothly rounded especially in dorsal view. No sexual dimorphism has been observed. The only other comparable genus is *Galliaecytheridea*, but it differs in lateral outline and is therefore not considered to be related.

Family uncertain

Genus ***WOLBURGIA*** Anderson 1965

Wolburgia visceralis (Anderson)

(Pl. 8, figs. 14, 15)

1940 *Cythere visceralis* Anderson : 374, pl. 19, fig. 11.
1966 *Wolburgia visceralis* (Anderson) Anderson: 443, text-figs. 12, 27

MATERIAL. Seventy-six valves and carapaces from various beds at the Bugle Pit (see Table I). One valve from Bed WH 6 at Warren House Farm, Stewkley (see Table III). Beds of similar age have yielded seventy-seven valves and carapaces at Long Crendon and one hundred and three valves and carapaces at Coneyhill.

DESCRIPTION. Lateral outline subtrapezoidal with the greatest height at the centre. Anterior margin is obliquely rounded, sharpest towards the venter. Posterior margin also oblique forming a rounded angle with the dorsal margin. The left valve is slightly larger than the right valve. Carapace is subelliptical in dorsal view with the greatest inflation at the centre.